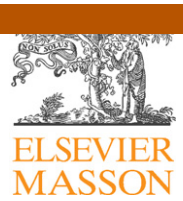
Orthopaedics & Traumatology: Surgery & Research (2012) **98**, 552—558



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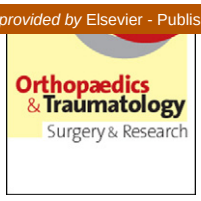

ORIGINAL ARTICLE

Posterior approach for surgical treatment of neglected elbow dislocation

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Accepted: 19 March 2012

KEYWORDS
Elbow;
Dislocation;
Neglected;
Triceps muscle plasty;
Posterior approach

Summary
Introduction: Neglected elbow dislocations often result in contracture and functional impairment. Surgical treatment is challenging because of the accompanying triceps retraction. We wanted to share our experience in treating these neglected dislocations using the posterior approach.
Patients and methods: This was a consecutive, prospective study over a 4.5-year period (January 2003 to June 2007) that included all the patients who presented with a neglected elbow dislocation that was older than 21 days. We treated 22 patients (17 men, five women) with an average age of 22.8 ± 8.2 years (range 14 to 46 years). The dislocations were 8.5 ± 4.2 months old on average (range 2 to 17 months). Average elbow flexion was 46.0° ± 25.9° (10° to 90°) and the extension deficit was 19.5° ± 18.4° (0° to 60°) before the surgery. A paratricipital approach was used in all patients. In 14 patients, the dislocation was reduced without triceps lengthening. In eight patients, a V-Y plasty of the triceps muscle was required.
Results: The average follow-up was 21 months (range 12 to 30 months). The improvement in the overall range of motion was statistically significant. Average elbow flexion was 112.7° ± 13.3° (60° to 130°) and the extension deficit was 26.6° ± 17.0° (0° to 60°). The average Mayo Clinic Elbow Performance Index score was 86 (range 50 to 100), with 14 excellent, four good, two average and two poor results. Complications included three cases of ulnar nerve paresis, which subsided within three months, and one case of superficial infection.
Discussion: Although surgical treatment is challenging, the functional improvement in neglected elbow dislocations is outstanding. The best functional results can be expected when the triceps splitting approach to the elbow is not used.
Level of evidence: IV.

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1877-0568/$ - see front matter © 2012 Published by Elsevier Masson SAS.
doi:10.1016/j.otsr.2012.03.006

Introduction

Neglected elbow dislocations are common in developing countries. The main reason for the delayed diagnosis is that patients initially seek treatment from bonesetters who immobilize the elbow in extension. This leads to retraction of the triceps muscles and collateral ligaments. The resulting non-functional elbow contracture makes the surgical procedure quite challenging [1,2].

If these dislocations require surgical treatment, the surgeon has many options to consider: surgical approach, need for triceps lengthening (plasty), stabilization of the elbow after reduction, and repair of collateral ligaments [2—8].

The goal of this work was to share our experience in treating these neglected dislocations using the posterior approach.

Patients and methods

Patients

This was a consecutive, prospective study over a 4.5-year period from January 2003 to June 2007. The study included all the patients who presented with a neglected elbow dislocation, isolated or not, which was more than 21 days old and treated surgically in our department. Patients presenting with elbow ankylosis were excluded from this study. In all, 22 patients were included. There were 17 men and five women, with an average age of 22.8 ± 8.2 years (range 14 to 46). The dislocations were 8.5 ± 4.2 months old on average (range 2 to 17 months). All the patients were right-handed and the dominant arm was affected in 27% of cases. They had various occupations: ten did manual work (builder, mechanic, fisherman, farmer), seven were students and five were housewives. The dislocations occurred because of injuries at home in eight cases, during sports in six cases, during play in four cases, during work in three cases and during a brawl in one case.

All the patients sought treatment because of limited elbow mobility. Four patients had moderate pain.

Anatomically, all the patients presented with a posterior dislocation: two were purely posterior, four were posteromedial and 16 were posterolateral. In nine cases, only the dislocation was present. In seven cases, the dislocation was associated with a fracture (three medial epicondyle fractures, two lateral condyle fractures and two radial head fractures). The coronoid process appeared normal on X-rays in all cases. In two patients, the displacement resulted in 5 cm of bone overlap. Heterotopic ossifications were present in 12 cases (Fig. 1); based on the Hastings classification [9], nine of these were type IIa and three were type IIc.

None of the patients could flex their elbow beyond 90° (Fig. 2); the average elbow flexion was $46.0° \pm 25.9°$ (10° to 90°). The average extension deficit was $19.5° \pm 18.4°$ (0° to 60°) and the average range of motion was $26.6° \pm 25.4$ (0° to 90°) before the surgery.

All the patients had difficulty performing activities of daily living and had an average Mayo Clinic Elbow Performance Index [10] score of 53 (range 25 to 75). Three different surgeons operated on these patients; 75% of the procedures were performed by one surgeon.

Figure 1 A/P and lateral X-rays of a patient with posterior dislocation of the right elbow and heterotopic ossifications.

Methods

Patients were operated under regional or general anaesthesia. Patients were placed on an ordinary surgical table in lateral decubitus on the contralateral side; the injured arm rested on a pad and the forearm and hand were left to hang. A tourniquet cuff was placed proximally on the arm.

We used the posteromedial and posterolateral midline paratricipital approach in all patients. The ulnar nerve was identified and isolated with an elastic band, and then a posterior capsulotomy was performed to access the joint surfaces. In all cases, the triceps had retracted. The collateral ligaments were retracted to various degrees in all patients. In all cases, fibrosis existed in the olecranon fossa; heterotopic ossifications were present in six cases. The joint surfaces were normal in three cases. In four cases, the joint surfaces were extensively remodelled (Table 1: Case No. 3 and Case No. 10). The olecranon was covered with fairly thick fibrous tissue in ten cases. In five cases, the appearance of the joint surfaces was not specified.

Arthrolysis was performed in all cases. Any fibrotic tissue, osteophytes and heterotopic ossifications were resected. Reduction was obtained with slow, gentle, progressive maneuvers to avoid sudden movements that could injure the cartilage. As the triceps and ligaments progressively released, reduction was possible in most cases. If the collateral ligaments were too retracted to perform the reduction, they were detached from their proximal insertion. If reduction was still not possible because of significant triceps muscle retraction, we then performed an inverted V-Y triceps plasty [11]. In nine patients, the dislocation was reduced without a triceps procedure; the dislocation was less than 9 months old in all of these patients. In five other patients, reduction could only be achieved once the lateral collateral ligament was detached from its insertion. For the

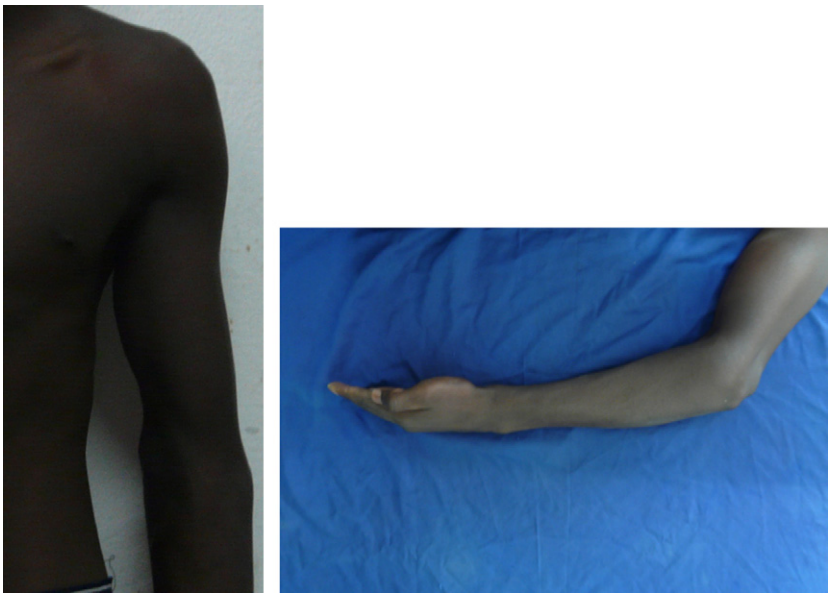

Figure 2 Clinical appearance of flexion and extension in this patient.

other eight patients, a V-Y triceps plasty was required to reduce the joint. Among these, two patients presented with 5 cm of overlap between the two bones and their injury was less than 6 months old (Table 1: Case No. 1 and Case No. 5).

Once the joint was reduced, condylo-radial K-wires (eight cases) or olecrano-humeral K-wires (seven times) or both together (seven times) were used to stabilize the elbow at 90° for an average of 25 days (range 20 to 32 days). The ligaments were repaired in only five of 13 cases, with reinsertion in two cases; in three patients, we sutured fibrous tissue to the ligament stump, to avoid placing excessive tension on the ligament.

After implanting a suction drain and closing the incision, an above-elbow cast was set up with the elbow at 90° until the K-wires were removed. All the patients underwent the same functional rehabilitation protocol; this was done on an outpatient basis with active mobilisation during the first two weeks and then a combination of active and passive work afterwards.

The patients were evaluated with the Mayo Clinic Elbow Performance Index [10]. X-rays were done to evaluate condyle-radius and olecranon-humerus alignment; the joint cartilage was evaluated based on the Knirk and Jupiter classification for post-traumatic elbow arthritis [12].

Results were analysed with statistical software (SPSS, version 18); a paired T-test and logistical and linear regression analyses using the Chi^2 test were also performed. The statistical test was considered significant if the p value was below 0.05.

Results

There were a few complications:

- ulnar nerve paresis in three cases, which resolved after three months;
- one case of superficial infection in a patient who had a triceps plasty. The infection was resolved by revising the surgical wound and using appropriate antibiotics.

The average follow-up was 21 months, with a minimum of 12 months and maximum of 30 months (Table 1).

In terms of function, the average Mayo Clinic Elbow Performance Index was 86 (range 50 to 100), with 14 excellent, four good, two average and two poor results. The two poor results were in one patient who had an infection and one patient with abnormal joint surfaces and heterotopic ossifications.

Slight pain during sustained, repetitive work was found in four patients, three of whom had a triceps plasty. For these four patients, there was one good, one average and two poor results. None of the other patients had pain.

Average flexion was 112.7° ± 13.3° (60° to 130°) and the average extension deficit was 26.6° ± 17.0° (0° to 60°). The average range of motion was 85.6° ± 26.6° (0° to 125°). Flexion was greater or equal to 100° in 18 cases (Fig. 3). None of the patients complained of instability when performing activities of daily living; clinical examination did not find any instability.

All of the patients had returned to their previous occupation. Fourteen patients had no discomfort during activities of daily living. Five of these patients were students and were able to continue their studies. Three patients had some discomfort. Four other patients had trouble bringing their hand to their mouth and combing their hair, thus they were not satisfied with the results; among them, three had only 90° of flexion and one had 95° of flexion.

Analysis of the X-rays showed that the dislocation had been reduced in all cases; the humeroulnar and humeroradial joints were aligned correctly (Fig. 4). According to the Knirk Jupiter classification [12], six patients were at Grade 0, 11 at Grade 1 and five at Grade 2. The four patients with average and poor functional outcomes were at Grade 2.

Table 1 Preoperative and postoperative results for every patient.

Patient (case No.)	Age (years)	Gender	Side	Delay (mo.)	Preoperative mobility (deg)			Postoperative mobility (deg)			Surgical procedure	Score
					E1	F1	A1	E2	F2	A2		
1	30	Male	L	4	0	10	10	35	125	90	T plasty	95 Ex
2	18	Male	L	12	0	30	30	60	100	40	T plasty	55 Po
3	21	Male	L	10	45	45	0	40	90	50		45 Po
4	30	Female	R	6	15	80	65	10	120	110		95 Ex
5	33	Male	R	3	0	20	20	50	115	65	T plasty	85 G
6	15	Male	L	4	0	90	90	25	120	95		95 Ex
7	24	Female	R	6	0	70	70	40	95	55		75 G
8	26	Male	L	2	60	60	0	40	130	90		85 G
9	31	Female	L	12	0	10	10	30	90	60	T plasty	65 Av
10	21	Male	L	12	20	20	0	60	90	30		70 Av
11	19	Male	L	8	15	50	35	0	125	125		100 Ex
12	18	Male	L	17	0	15	15	15	110	95	T plasty	95 Ex
13	18	Male	L	6	50	50	0	30	120	90		95 Ex
14	35	Female	L	2	30	60	30	5	130	125		100 Ex
15	14	Male	L	8	15	45	30	20	120	100		95 Ex
16	46	Male	L	14	15	15	0	30	105	75	T plasty	95 Ex
17	16	Male	R	8	10	30	20	15	110	95	T plasty	80 G
18	16	Male	L	12	30	30	0	25	100	75	T plasty	95 Ex
19	18	Female	L	10	45	90	45	10	120	100		95 Ex
20	15	Male	R	9	20	60	40	10	130	120		100 Ex
21	19	Male	L	9	30	80	50	0	120	120		100 Ex
22	20	Male	R	15	30	55	25	20	120	100		95 Ex
Average	22.7			8.6	19.5	46.1	26.6	26.6	112.7	85.7		
Min	14			2	0	10	0	0	90	30		
Max	46			17	60	90	90	60	130	125		
Std. Dev.	8.2			4.2	18.4	25.9	25.4	17.0	13.3	26.6		

R: right; L: left; A1: preoperative ROM; E1: preoperative extension; F1: preoperative flexion; A2: postoperative range of motion; E2: postoperative extension; F2: postoperative flexion; T plasty: triceps plasty; Ex: excellent; G: good; Av: average; Po: poor.

Figure 3 Clinical evaluation of flexion and extension at 24 months after the surgery.

There was no correlation between the age of the dislocation and the improvement in the range of motion ($P = 0.68$).

There was a statistically significant improvement in flexion of 66.5° and overall range of motion of 59° ($P < 0.001$). An average of 7° was lost in extension. There was a statistically significant relationship between the degree of preoperative flexion and the need for a triceps plasty ($P < 0.001$).

Discussion

Neglected elbow dislocations are common in developing countries. Patients first consult bonesetters, who use massage, forcible manipulations and immobilisation in extension to address the problem. This approach not only delays the diagnosis and treatment, but also leads to complications

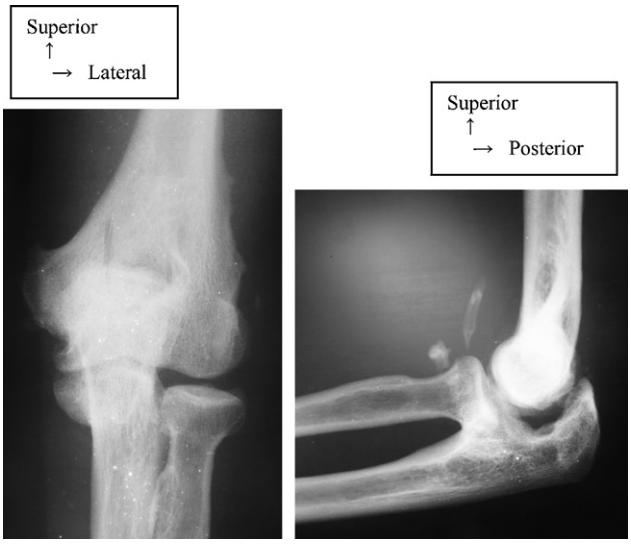

Figure 4 A/P and lateral X-rays at 24 months after the surgery.

such as heterotopic ossification, entrapment of the ulnar nerve [13] and compartment syndrome, which can result in disabling consequences for the patient.

For a long time, surgery was not advocated [14—16]. But after multiple published series describing good results from open reduction, surgical treatment is now back in favor [2—8,11,17—19]. Surgery is indicated based on how the patient tolerates the associated elbow stiffness [1,8,17,20] and on the age of the dislocation.

Martini et al. [1] suggested that elbow flexion of 80—90° corresponds to functional stiffness. In these cases, surgery should not be performed. In cases where a maximum of 80° of flexion can be achieved, despite using the shoulder and hand to compensate, the stiffness makes the arm non-functional. Most authors advocate only operating on the latter group of patients [1,2,4,5,7,8,17,18,20,21].

If the dislocation is less than six months old, the surgery is easier since the tissues (triceps and ligaments) are minimally retracted [21]. Except for two patients with significant bone overlap (5 cm of shortening), we were able to reduce eight of the dislocations without having to resort to ligament transection or triceps plasty. The injury was less than eight months old in these patients; they all had either good or excellent results.

When the dislocation is older (more than six months), indications for surgery are not as straight-forward [1]. Based on our experience, if the dislocation results in the patient having less than 90° of elbow flexion, it should be surgically reduced. Even patients with 90° of elbow flexion are not able to bring their hand to the mouth, which is a particular concern in our region because food is eaten by hand with the right arm only. All of our patients had a non-functional range of motion and requested the procedure. We found no correlation between the age of the dislocation and functional outcomes, as had been described previously [7]. Patients with a dislocation that was more than six months old had good and excellent results in 71.5% of cases. In the other 28.5% of cases, half of these patients had abnormal joint surfaces.

The posterior and lateral approaches are used most often in open reduction [3,4,7,17—19]. The lateral approach advocated by Krishnamoorty [6] has the advantage of providing a good exposure of the humeroradial joint and the anterior structures, particularly the coronoid fossa. However, the posteromedial capsule cannot be accessed and the ulnar nerve cannot be controlled. This approach is often paired with a medial approach, but this creates a second scar.

As with many others, we prefer to use the posterior approach instead of the combined lateral and medial approaches [2—4,7,8,11,13,17—19,21]. The posterior approach provides good exposure to the posterior structures that are typically retracted; it is also easy to perform a V-Y triceps plasty and an ulnar nerve transposition, when needed. The joint is reduced and fixed under direct visual control [7]. The overall aesthetics are also preferable, since there is only one surgical scar.

If the triceps is significantly retracted, two main lengthening techniques are used: the V-Y triceps plasty described by Speed [11] (most commonly used [2—4,7,8,17,18]) and the procedure described by Vangorder [19]. The latter uses an Achilles tendon or fascia lata allograft after the triceps is sectioned transversely. This procedure requires another surgical preparation and could affect the healing and mechanical outcomes at the elbow.

Although the V-Y triceps plasty is simple and reduction is easy to perform, this procedure has its disadvantages [2,21]. It leads to more pain after surgery, an extension deficit [4,18,21] and less available strength for manual work. Recovery is slow and requires patients to be highly motivated to complete the required rehabilitation. We agree with this assessment. Among our four poor and average results, two had a triceps plasty and there was one case of postoperative infection, which also occurred in their series. We believe that triceps plasty should not be systematically performed. Based on our experience during the first six months post-dislocation, the triceps can mobilized gradually during the reduction maneuvers, unless its retraction is significant. No matter the age of the dislocation, even cases where the elbow had only 40° of flexion before surgery, the dislocation could be reduced without triceps lengthening (Table 1).

There was a statistically significant relationship between the degree of preoperative flexion and the need for a triceps plasty ($P < 0.001$). The extended position and associated shortening increase triceps retraction; this does not allow the triceps to be mobilized sufficiently to let the coronoid process pass under the trochlea.

Surgery for neglected dislocations is typically conservative [1,3—8,17,18,21]. When the joint surfaces are significantly damaged, or if open reduction fails, distal humerus resection [20,22] is an alternative to joint fusion, as the latter would greatly reduce the mobility of the joint. This resection arthroplasty still provides good range of motion, but leads to residual joint instability and reduced muscle strength.

We and others believe that greatly retracted collateral ligaments do not need to be repaired to restore elbow stability [3—5,7,17,18,21]. Ligament repair has been described by Arafiles using an allograft from the palmaris longus or extensor radialis longus tendons [2]. This method requires much longer procedure times and increases the risk of morbidity because of the second surgical site. The technique

Table 2 Compared functional results.

Authors	Essi et al. [8]	Fowles et al. [4]	Naidoo [18]	Mahaisavariya and Laupattarakasen [7]	Mehta et al. [17]	Current series
Extension deficit	94.5°	55°	40.4°	40°	13°	26.5°
Flexion	53°	112°	116°	122°	115°	112.7°
Range of motion	41.5°	67°	75.8°	82°	102°	86°

used by Jupiter and Ring is attractive [5]. They used an articulated external fixator, but not everyone can perform this type of procedure. The advantage of these two techniques is that they provide immediate stability, which allows for early mobilisation during the first week post-surgery, and results in better functional results (105° and 113° of post-surgery range of motion was reported by Arafiles [2] and Jupiter and Ring [5], respectively). This stability is obtained by cast immobilisation or even better with K-wires for two to three weeks to avoid recurrence of the dislocation [4,7,8,17,18,21]. This period of time is sufficient for the ligaments and triceps to heal. The disadvantage of this lengthy immobilisation is that a greater extension deficit reduces the overall range of motion; in our opinion, a triceps plasty can counter these effects.

We compared our functional results to published results where the same surgical technique was used (Table 2). We decided to only compare the functional results because the Mayo Clinic Elbow Performance Index is not well-suited to neglected dislocations. In this scoring system, the lack of pain or the presence of moderate pain is heavily weighted (45 points) [5,8]. This means that a patient could have a good or average result, but his/her overall function is non-existent (Table 1: Case No. 7 and Case No. 10). Our results are comparable to those of Fowles et al. [4], Naidoo [18], Mahaisavariya and Laupattarakasen [7] and of Mehta et al. [17] who reported an average flexion greater than 110° in their series. Other than Mehta et al. [17], we had a smaller average extension deficit in our series (26.5°), which can be attributed to our lower rate of triceps plasty.

The main complication in our series was ulnar nerve paresis, which resolved two to three months after the surgery. There was also one case of infection, which negatively affected the results [2,4,5,17], as it reduces the range of motion and can lead to elbow ankylosis [8]. We did not need to treat the heterotopic ossifications by indomethacin or irradiation (which is not commonly available in Senegal) because they did not progress.

Conclusion

Neglected dislocations are a reality in our country. Despite challenging surgical treatment, the functional improvement and restoration of function is dramatic. A midline paratricipital posterior approach has many advantages and reduction can be achieved in most cases, without needing to use the triceps splitting approach. The reduced joint is stable even without repairing the collateral ligaments; fixation is needed for two or three weeks; if available, an external fixation can be used instead to provide early mobilisation. This surgery is usually conservative; resection arthroplasty is limited to cases with significant joint destruction and failure of elbow reduction with resulting stiffness that makes the arm non-functional.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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